PATENT SPECIFICATION

DRAWINGS ATTACHED

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898,955

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International Classification:—F06l.

COMPLETE SPECIFICATION

Improvements in Pipe Couplings

We, EXACTOR LIMITED, a company organised under the laws of Great Britain, of Church Way, Edgware, Middlesex, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to pipe couplings of the type in which the pipes to be coupled terminate in end fittings equipped with valves which are loaded to move automatically to close their fittings as the fittings are separated and which are opened simultaneously as the two fittings are engaged to one another to establish a fluid flow connection. In such couplings the valve seating of one end fitting is arranged to engage and displace the valve of the other end fitting so that both valves are opened simultaneously.

In such couplings the valves are subjected to the pressure of the fluid and are so arranged that this pressure acts to produce a closing bias on the valves and usually this bias is supplemented by a spring. When relatively high fluid pressures are involved the biasing pressure is correspondingly high requiring a substantial effort on the part of the operator to make the coupling which involves moving both of the valves against the bias acting on them.

In order to reduce the effort, it has been proposed to arrange the valves so that on coupling they are moved sequentially, one being cracked open (so relieving the biasing pressure acting on that valve) before the other valve commences to open. The present invention is however concerned as stated with the kind of coupling in which the valves are opened simultaneously and the object of this invention is to enable such valves when initially cracked open to have their opening completed regardless of the fluid pressure.

According to the present invention a pipe coupling of the kind referred to comprises two valves formed with pressure areas disposed to be subject to the pressure of the fluid and so proportioned and disposed that the pressure of the fluid produces a closing bias on the valves when the fittings are not coupled and that the forces exerted by the fluid on the valve are balanced out when the valves are unseated as the two fittings are engaged to one another whereby the completion of the opening of the valves can be effected independently of the pressure of the fluid.

In its preferred form the construction of the pipe coupling is such that the total fluid contained in the two end fittings when assembled is substantially the same as the total fluid contained in the individual end fittings when dis-assembled, whereby assembly and dis-assembly of the end fittings does not result in displacement of fluid into or from the flow lines.

Preferably the valves are ring valves and preferably there is a groove in either the valve seating or the ring valve, said groove having side wall tapering inwardly from the bottom of the groove, and a sealing ring snugly received in said groove, said sealing ring effecting a fluid-tight seal between the valve seating and ring valve and said groove and sealing ring being such that hydraulic forces in the flow line will urge the sealing ring into the groove.

The arrangement of the ring valve provides an annular flow space which can readily be selected to provide an unthrottled flow when the valve is opened.

The invention is illustrated merely by way of example in the accompanying drawings, in which Figure 1 is a sectional elevation of a pipe coupling in the closed condition and comprising two end fittings each of which is equipped with a self-closing valve, the first end fitting being in the form of a hollow spigot and the second in the form of a socket to receive the spigot, Figure 2 is a view similar to Figure 1 but showing a somewhat modified

pipe coupling, and Figure 3 is a view similar to Figure 2 but showing the coupling in the open condition.

Referring to Figure 1, the spigot or first fitting 1 comprises a hollow barrel 2 to which the end of a pipe (not shown) is secured. The barrel 2 has in its bore a spider 3 from which extends forwardly out of the barrel a stem 4 carrying at its outer end a disc 5 having at its periphery a forwardly extending flange 6. The junction between the flange 6 and the disc 5 is sloped to form a conical valve seating 7 which tapers inwardly towards the barrel 2. The valve seating 7 has a mean or effective sealing diameter C.

The barrel 2 at its forward end is formed with a cylindrical bore in which is slidably mounted a sleeve 8 which forms a ring valve; this valve has an outer diameter B_1. The sleeve 8 has its forward edge 9 formed as a hollow cone to cooperate with the valve seating 7 on the disc 5, the sleeve 8 forming in effect a continuation of the flow space formed by the barrel 2.

The sleeve 8 is counter-bored from its trailing end to accommodate a biasing spiral spring 10 which at one end abuts against the shoulder 11 formed by the counterbore and at the other end abuts against a shoulder 12 in the bore of the barrel 2.

When the end fitting 1 is in use, the valve sleeve 8 is urged forwardly to close the fitting not only by the spring 10 but also by the hydraulic loads which act on the valve sleeve 8 in a closing direction. The extent of these loads will be a function of the difference between the outer diameter B_1 of the valve sleeve 8 and the effective sealing diameter C of the valve seating 7. Since B_1 is greater than C, there will, be an hydraulic force biasing the valve sleeve 8 in a valve-closing direction.

The socket or second end fitting 15 comprises a barrel 16 which swells out in diameter towards its forward end and has within it a coaxial cup-shaped inner component 17 which provides between itself and the barrel an annular flow space 18. The component 17 is hollow, being blanked off at one end (except for a bleed hole 17^1 to atmosphere) but open at the other (or forward) end. The flow space 18 is blanked off at the forward end of the barrel 16 by an annular inturned flange 19 on the barrel 16. The flange 19 has an axial opening 19^1 which is sloped at its rear face to provide a conical valve seat 20 to be engaged by the correspondingly coned end 21 of a ring valve which is formed by the end of a sleeve 22. The seat 20 has a mean or effective sealing diameter D. The sleeve 22 is reduced rearwardly to slide in the inner bore of the hollow inner component 17, the bore having a diameter A_1. The sleeve 22 has an inturned flange 23 against which reacts one end of a helical spring 24 which at the other end reacts against the blanking off wall 25 of the inner component.

It will be appreciated that the hydraulic load on the sleeve 22 will be a function of the difference between the outer diameter of the sleeve and the diameter D and that this load will act in a valve-closing direction.

The inturned flange 23 on the sleeve 22 is spaced to the rear of the coned end 21 of the sleeve so as to form a socket 27 to receive snugly the flange 6 (which constitutes a spigot) on the seating disc 5 of the first end fitting 1. This socket 27 has a diameter A_2. The opening 19^1 in the flange 19 on the barrel 16 of the second fitting 15 is formed to receive snugly the outer diameter of the sleeve valve 8 on the first fitting at a zone where it has a diameter B_2. Thus the spigot is formed by the two parts, the flange 6 on the valve seating disc 6 and by the sleeve valve 8 of the first end fitting: the socket is formed by the two parts, the flange 19 having the valve seating 20 and socket 27 formed by the sleeve 22.

Provision is made to provide a resilient fluid-tight seal between the conical surfaces of the valves on the two fittings. This could be effected as by providing in each fixed conical seating a groove 35 accommodating a flexible sealing ring 35^1 with provision to enable the ring first to be engaged by the corresponding coned end of its sleeve valve and then to be compressed to allow metal-to-metal contact to be effected between the seating and the sleeve. It will be noted that the sides of the groove 35 taper inwardly, from the bottom of the groove, and that the sealing ring 35^1 is substantially triangular in section. This is to ensure that the sealing ring will not, in operation, be pulled out of the groove, the hydraulic forces in fact acting to force the ring into the groove.

Alternatively, one of the conical surfaces of each of the two valves could be formed with a resilient tongue which first seals the valve and then is distorted to allow metal-to-metal contact to take place. The diameters C and D referred to have been taken as the diameter at the contact circle at the mean diameter of the sealing ring.

Sliding seals would also be arranged at 28 between the spigot flange on the first part (i.e. along the diameter B_2) and the socket of the second part, at 29, between the sleeve valve 22 (i.e. along the diameter A_2) and the end flange 6, at 30 between the sleeve 8 and the barrel 2 (i.e. along the diameter B_1) and at 31 between the sleeve valve 22 and inner component 17 (i.e. along the diameter A_1).

As is usual in this kind of coupling, each fitting is constructed to move the valve of the complementary fitting positively from its seating: in the construction referred to this action is obtained by arranging firstly the end of the flange 6 on the valve disc 5 to engage a wall 32 of the valve sleeve 22 and secondly the end wall 33 of the flange 19 to abut at the same

time a shoulder 34 formed between the diameters B, B externally of the sleeve valve of the first part.

The various diameters should in accordance with this invention have the following relationships. Diameter A_1 should be substantially equal to diameter A_2 both of which should be slightly smaller than diameter D to afford a slight bias to closing in the uncoupled position. Similarly, diameters B_1 and B_2 must be substantially the same but slightly greater than diameter C thus affording a similar bias under the same conditions.

Thus with this proportioning as the end fittings are engaged to one another and then it is necessary to overcome the bias due to the fluid pressure acting on the diameters C,D and the spring pressure: as soon however as the valves 8 and 22 are unseated, the fluid pressure acts on the valves on the diameters A_1, A_2, B_1, B_2 and as the fluid pressures are now balanced further opening movement can be easily effected.

This arrangement is of importance especially when high pressures are employed for when once the valves have been potentially unseated they can easily be moved fully open regardless of the fluid pressure.

Any convenient mechanism can be provided on the complementary end fittings firstly to draw them to one another to establish the flow connection by opening the valves and then to hold them releasably together. One convenient arrangement consists in providing the inner end of the barrel 2 of the first fitting with an external turnable sleeve 26 having a plurality (e.g. three) of pins 36 (only one shown) carrying a roller 36^1 received in a cam track 37 in a sleeve extension 38 of the flange 19, the sleeve 26 being fast with a handwheel 39 by which it can be turned to "cam" the two fittings towards one another.

In figures 2 and 3 there is shown a pipe coupling which is generally similar to that of Figure 1 and which for this reason will not be described in detail. In the construction of Figures 2 and 3 however, the disc 5 is secured by a tie rod 40 to a support integrally connected to the fitting 1 by a pair of webs 41. Similarly, the inner component 17 is integrally connected to the fitting 15 by a pair of webs 42.

The interior of the component 17 in Figures 2 and 3 is vented to the atmosphere by a bleed hole 43. Thus if hydraulic liquid should leak past the sealing rings, 29 or 31, it will not raise the pressure of the air within the component 17 to the dangerously high level which might otherwise occur. Furthermore, such leakage will ultimately result in liquid being emitted from the bleed hole 43 so that the existence of the leakage will be made apparent.

The mechanism, in the construction of Figures 2 and 3, for drawing the end fittings 1, 15 together so as to establish flow between them, comprises a sleeve 44 rotatably mounted on the end fitting 1 and provided with a plurality (e.g.) of pins 36 (only one shown) bearing rollers 36^1 received in a cam track 37. A handle 46 permits the rollers 36^1 to be moved in the track 37 and the end fittings consequently to be "carried" towards each other. Interposed between the inner end of the sleeve 44 and a shoulder 46 on the end fitting 1 is a thrust bearing 47.

It will be appreciated that the specific mechanism described in the preceding paragraph for drawing the end fittings together can be replaced, if desired, by a screw mechanism and it will also be appreciated that the sleeve 44 may be mounted on the end fitting 15, the cam track 37 being provided on the end fitting 1.

In Figure 3, the coupling is shown in its open condition. It will be noted that, by virtue of the fact that the surfaces 48, 49 of the sleeve 22 have the same diameter, the net hydraulic thrust on the sleeve 22 when the latter is in the open position is nil. That is to say, there is no hydraulic force tending to move the sleeve 22 in either direction. The sleeve 22 is indeed forced against the flange 6 only by the spring 24. Similarly, by virtue of the fact that the diameters B_1 and B_2 of the sleeve valve 8 are substantially the same, the net hydraulic thrust on the valve sleeve 8 when the latter is in the open position is also nil, the shoulder 34 being forced against the end wall 33 only by the spring 10.

WHAT WE CLAIM IS:—

1. A pipe coupling of the kind referred to and wherein the two valves are formed with pressure areas disposed to be subject to the pressure of the fluid and so proportioned and disposed that the pressure of the fluid produces a closing bias on the valves when the fittings are not coupled and that the forces exerted by the fluid on the valves are balanced out when the valves are unseated as the two fittings are engaged to one another whereby the completion of the opening of the valves can be effected independently of the pressure of the fluid.

2. A pipe coupling as claimed in claim 1 and wherein the two valves are axially displaceable ring valves each having a conical closure face to cooperate with a conical static seating and wherein also the seating of one valve is in the form of a head with its ring valve disposed about it and the seating of the other valve is in the form of an annulus disposed about its ring valve, the head of the one valve fitting and the annulus of the other valve fitting being arranged to engage and displace the two ring valves at the same time and wherein the components of the coupling have the relative dimensions as herein described.

3. A pipe coupling as claimed in claim 2 and wherein sealing rings are provided between

the conical faces of the valves and their respective seatings.

4. A pipe coupling as claimed in any of the preceding claims and wherein the valves of the two end fittings are acted on by springs biasing the valves into engagement with their seatings.

5. A pipe coupling as claimed in any of the preceding claims and comprising means for moving the end fittings into engagement with each other, the said means comprising a cam track formed on one of said fittings and a component movable in said cam track, and connected to the other fitting, a device being provided for moving the said component in the cam track.

6. A pipe coupling as claimed in claim 5 and wherein the device comprises a sleeve rotatably mounted on one of the end fittings adjacent a shoulder thereof and a thrust bearing interposed between the sleeve and shoulder, said sleeve carrying said component.

7. A pipe coupling substantially as described with reference to and as shown in Figure 1 or Figures 2 and 3 of the accompanying drawings.

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PROVISIONAL SPECIFICATION

Improvements in Pipe Couplings

We, EXACTOR LIMITED, a company organised under the laws of Great Britain, of Church Way, Edgware, Middlesex, do hereby declare this invention to be described in the following statement:—

This invention relates to improvements in pipe couplings of the kind in which the pipes to be coupled terminate in end coupling fittings one or both of which is equipped with a self-closing valve which is loaded to move automatically to close or seal its fitting when the two are separated and which is moved to open its fitting when the two are coupled.

Such a self closing valve is necessarily subjected when closed to the static pressure of the fluid which it is controlling in some cases the total pressure acting on the valve is high: in addition to bias it to the closed position at a time when the fluid pressure is low or non-existant as may happen in certain conditions. In the result thereof considerable pressure may be required to open the valve and this can give rise to considerable operating difficulties in achieving a coupling action.

In many applications it is essential that both of the fittings which are to be coupled together are fitted with a self-closing valve and clearly the force required to open both valves is further increased as the closing bias acting independently on the two valves has to be overcome.

The present invention has for its main object to provide such a construction of end fitting having a self-closing valve as will enable the closing bias derived from the standing or static pressure fluid controlled by it chosen to enable the force required to open it to be such as to facilitate that operation while at the same time ensuring an adequate closing action: in other words to enable the manipulation of the valve to be within actual operating possibilities regardless of the pressure loading due to the fluid being handled.

In carrying out this invention an end fitting to terminate a flow line is closed or blanked-off by a component having a peripheral valve seating and ring valve which co-operates with that seating to complete the closing of the fitting; the ring valve is formed with pressure surfaces which are disposed on the pressure side of the seating and are exposed to the flow space of the component, and these pressure surfaces are so selected in area as to produce a calculated pressure derived from the fluid pressure biasing the ring valve against the seating. The arrangement of the ring valve provides an annular flow space which can readily be selected to provide an unthrottled flow when the valve is opened: the pressure surfaces on the ring valve can readily be arranged to provide any desired biasing pressure by the use if necessary of surfaces which face upstream and downstream so enabling a nett resultant pressure of the required valve to be obtained regardless of the actual fluid pressure involved. Due allowance would be made for the bias exerted by the closing spring which would be provided as is usual.

A particular construction will now be described for an arrangement in which both of the end fittings to be coupled are equipped with a self-closing valve, the first end fitting being in the form of a hollow spigot and the second in the form of a socket to receive the spigot. In this description certain parts will for later reference be given a diameter indication which corresponds with the indication given on the attached drawing.

The spigot or first fitting comprises a hollow barrel to which the end of a pipe is secured: the barrel has in its bore a spider from which extends forwardly out of the barrel a stem carrying at its outer end a disc having at its periphery a forwardly extending flange. The junction between the flange and the disc is sloped to form a conical valve seating which tapers inwardly towards the barrel: this seating has a mean diameter C.

The barrel at its forward end is formed with a cylindrical bore in which is slidably mounted a sleeve which forms a ring valve;

this valve has an outer diameter B^1: this sleeve has its forward edge formed as a hollow cone to cooperate with the conical seating on the disc, this sleeve forming in effect a continuation of the flow space formed by the barrel.

The sleeve is counter-bored from its trailing end to accommodate a biasing spiral spring which at one end abuts against the shoulder formed by the counter-bore and at the other end abuts against a shoulder in the bore of the barrel.

When this end fitting is in use, the valve sleeve is urged forwardly to close the fitting not only by the spring but also by the contained fluid pressure which acts, in a closing direction, against the end face of the sleeve (i.e. on the diameter B_1) and against the shoulder in that sleeve which form pressure surfaces. In a case here the total pressure so acting is too great for ease in opening the valve, the construction lends itself to adjustment by forming on the sleeve another pressure surface facing in the opposite direction to those already referred to: this additional pressure surface causes the pressure fluid to set up an opposing pressure which can be chosen to have any desired value to leave a nett closing pressure of the desired value. Such an additional pressure surface can be formed by an extension of the conical end inwardly beyond the valve seating on the disc: the projected area of this extension enables the pressure fluid to set up the requisite opposing pressure.

In the case of the socket or second end fitting, this is comprised of a barrel which swells out in diameter towards its forward end and has within it a coaxial inner component which provides between itself and the barrel an annular flow space: this component is hollow, being blanked off at one end but open at the other end. The flow space is blanked off, at the forward end of the barrel, by an annular inturned flange on the barrel: this flange has a co-axial opening which is sloped at its rear face to provide a conical valve seat to be engaged by the correspondingly coned end of a ring valve which is formed by the end of a sleeve: this seating has a mean diameter D. This sleeve is reduced rearwardly to slide in the inner bore of the hollow inner component the bore having a diameter A_1: the sleeve has an inturned flange against which reacts one end of a spiral spring which at the other end reacts against the blanking-off wall of the inner component.

In the case of this second component, the sleeve valve is formed to the rear of its conical valve end with a shoulder which faces upstream and is exposed to the annular flow space: this shoulder forms a pressure surface on which the fluid pressure acts to bias the valve to its closing position. Again the area of this shoulder can be chosen to give the desired pressure when allowance is made for the closing action of the spring.

The inturned flange on the sleeve is spaced to the rear of the coned end of the sleeve so as to form a socket to receive snugly the flange (which constitutes a spigot) on the seating disc of the first end fitting this socket has a diameter A_2. The opening in the flange on the barrel of the second fitting is formed to receive snugly the outer diameter of the sleeve valve on the first fitting at a zone where it has a diameter B_2. Thus the spigot is formed by the two parts, the flange on the valve seating disc and by the sleeve valve of the first end fitting: the socket is formed by the two parts, the flange having the valve seating and socket formed by its sleeve.

Provision is made to provide a resilient fluid-tight seal between the conical surfaces of the valves on the two fittings: this could be effected as by providing in each fixed conical seating a groove accommodating a flexible sealing ring with provision to enable the ring first to be engaged by the corresponding coned end of its sleeve valve and then to be compressed to allow metal-to-metal contact to be effected between the seating and the sleeve. Alternatively one of the conical surfaces of each of the two valves could be formed with a resilient tongue which first seals the valve and then is distorted to allow metal-to-metal contact to take place. The diameters C and D referred to have been taken as the diameter at the contact circle at the mean diameter of the sealing ring.

Sliding seals would also be arranged between the spigot flange on the first part (i.e. along the diameter B_2) and the socket of the second part, between the sleeve valve (i.e. along the diameter A_2) of the first part and the opening in the end flange on the second part, between the sleeve valve of the first part and the barrel of that part (i.e. along the diameter B_1) and between the sleeve valve of the second part and inner component of the second part (i.e. along the diameter A_1).

As is usual in this kind of coupling, each fitting is constructed to move the valve of the complementary fitting positively from its seating: in the construction referred to this action is obtained by arranging firstly the end of the flange on the valve disc of the first part to engage the base wall of the socket in the valve sleeve of the second part and secondly the end wall of the flange on the barrel of the second part to abut a shoulder formed between the diameters B_1, B_2 externally of the sleeve valve of the first part.

In such a construction, the various diameters should have the following relationships for the purpose stated. If pressure balance is to be achieved, diameter A_1 should be substantially equal to diameter A_2 both of which should preferably be slightly smaller than diameter D to afford a slight bias to clos-

ing in the uncoupled position.

Similarly, diameters B_1 and B_2 must be substantially the same but slightly greater than diameter C, thus affording a similar bias under the same conditions.

Any convenient mechanism can be provided on the complementary end fittings firstly to draw them to one another to establish the flow connection by opening the valves and then to hold them releasably together. One convenient arrangement consists in providing the inner end of the barrel of the first fitting with an external turnable sleeve having a pin to be received in a cam track in a sleeve extension of the flange of the barrel of the second part, the sleeve having the pin being fast with a hand-wheel by which it can be turned to "cam" the two fittings towards one another.

In order to prevent an air cushion from being set up by air trapped in the interior of the hollow inner component of the second part when the two parts are presented to one another, that interior has a bleed-opening indicated at X.

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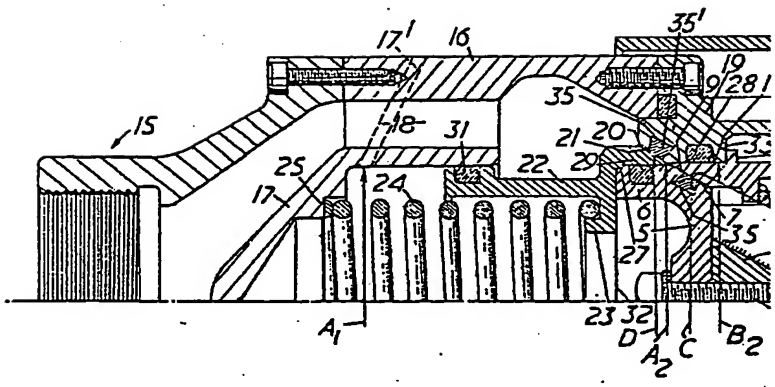
Published by The Patent Office, 25, Southampton Buildings, London, W.C.2, from which copies may be obtained.

FIG. 1.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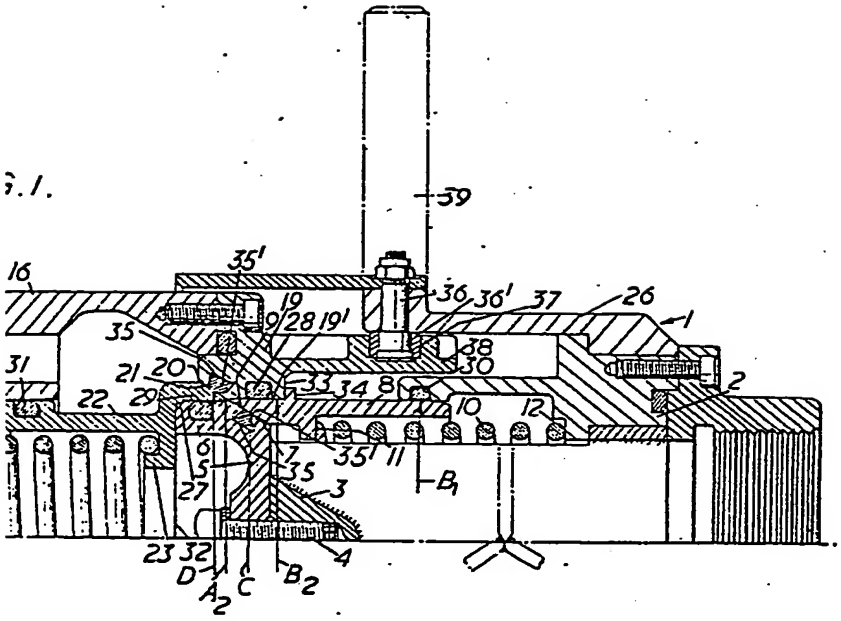
Sheet 1



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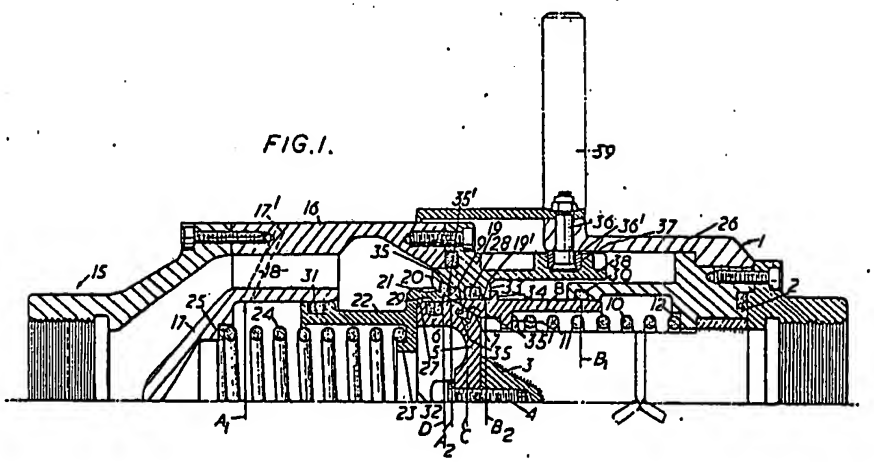
Sheet 1

FIG.1.



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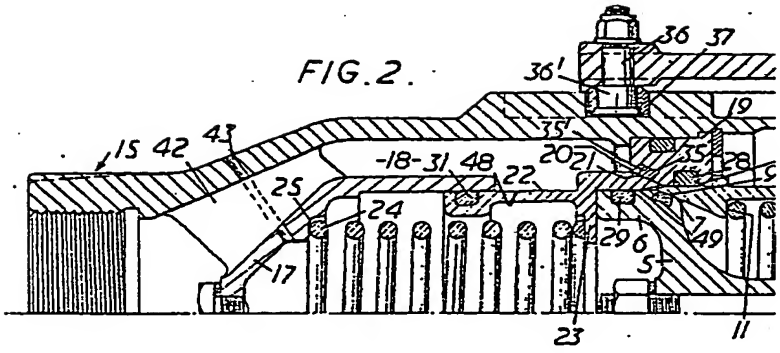
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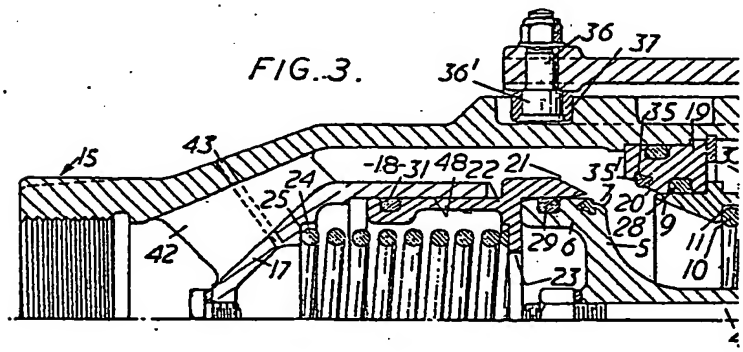
FIG. 3.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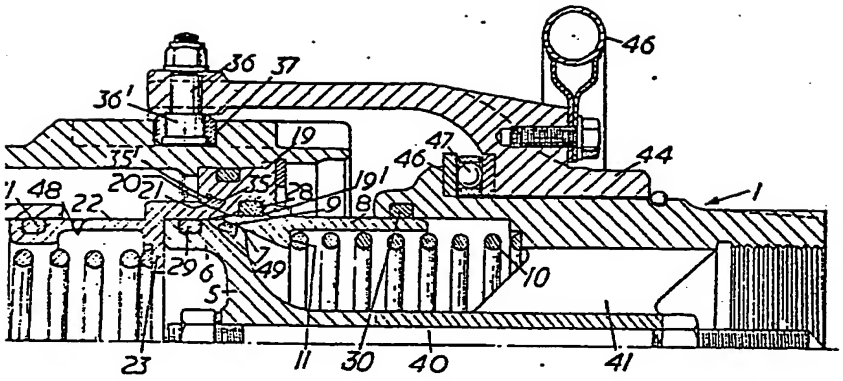
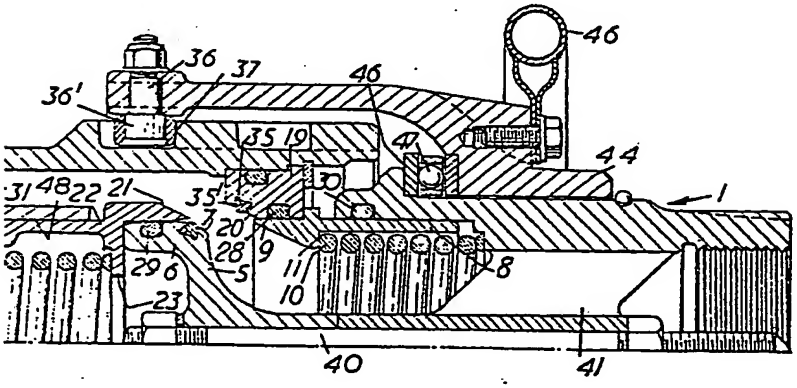
Sheet 2





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Sheet 2

FIG.2.

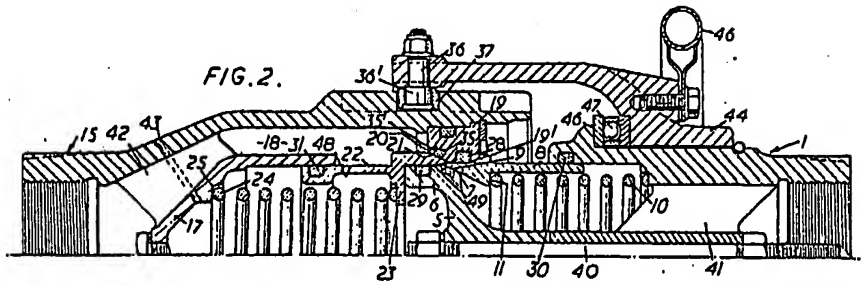
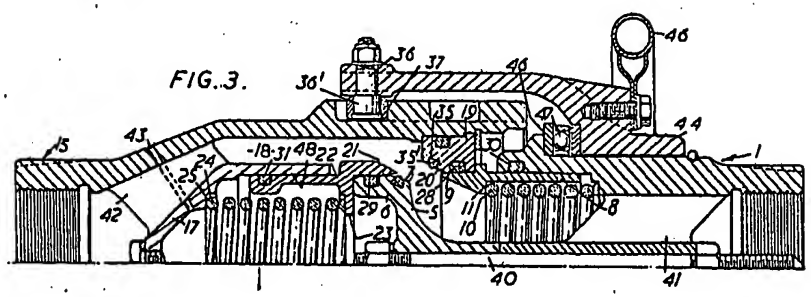
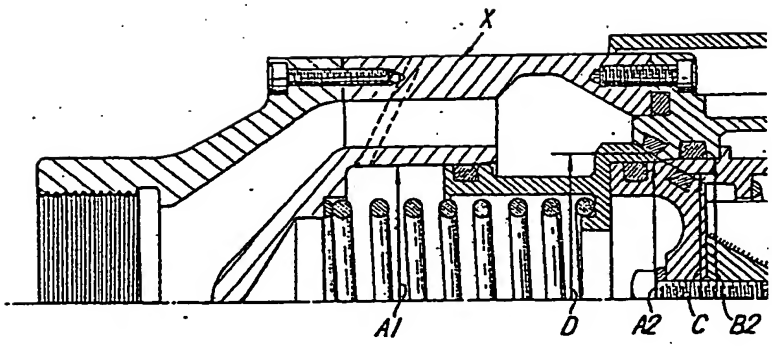


FIG.3.




X
A1
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C
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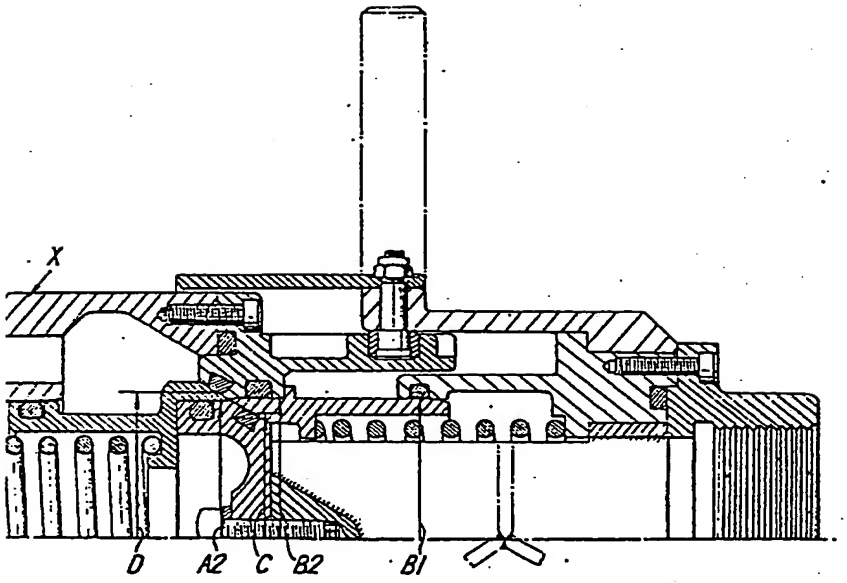

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